Introduction to EES 3310/5310 Labs

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Contents

Overview of EES 3310/5310 Labs

The laboratories in this course are computational. My goals for the laboratory section are:

1. Learn about best practices for *reproducible research* and get experience applying tools and methods for making sure that your research is reliable, reproducible, and trustworthy. We will focus on research about climate science and climate and energy policy, but the methods and tools we will use are widely used in all kinds of research in natural and social sciences and also in the private sector.
2. Get experience working with real data: download and analyze data and report the results of your analysis.
3. Get experience working with computer models of different aspects of the climate system. Learn how to use models to do science, how to analyze and interpret the results of model simulations, and how to write reports about research using computational models.

General Policies

- There will be **two** web resources for each lab:
  - **Documentation** that describes the lab and tells you what you need to do to prepare and what you will do in the lab class.
  - **An assignment** that provides a template you will use in carrying out the lab and writing it up. The assignment will consist of a web link for you to click on to accept the assignment in GitHub Classroom. After you accept the assignment, GitHub Classroom will copy the assignment into your own GitHub Classroom account. You will then clone the assignment from GitHub to your own computer or a computer in the lab classroom to work on it.

  Both the documentation and the assignment will be posted to the course web site at https://ees3310.jgilligan.org/schedule/ at least one week before the lab class.
- **Before** coming to lab:
  - Be sure to read the documentation for that week's lab.
    - Because the first lab of the semester is on the first day of class, this is an exception and you should read the documentation for the first lab during the following week, but **do be sure to read the documents for lab #2 before you come to lab on Monday, Jan. 13
  - Accept the assignment on GitHub Classroom (click on the Assignment link in the course web site). If you will be bringing your own computer to the lab, you may want to clone the assignment onto your own computer before you come to lab, but that's not strictly necessary. If you will be using one of the computers in the lab classroom, you can clone the assignment when you log in at the beginning of class.
- In the first lab, on

- Monday, Jan. 6, Ms. Best will explain all of the different software we will be using and will walk you through all the steps of using Git to work with your assignments.

Schedule for the Semester

The semester is divided roughly in half.

First Half of the Semester:

In the first half, the readings, class sessions, and laboratories will focus on understanding the science of how the earth's climate system works and how human perturbations to the environment may affect the climate.

The weekly labs during the first half of the semester will initiially focus on exercises from the book *Global Warming: Understanding the Forecast* and then on Feb. 17–Mar. 16 you will work in pairs to develop your own project to investigate a question about the climate using the computer models and/or data from the major climatic data archives.

Extended Lab Project The project has the following important dates:

- You and your partner will get your research topic approved by Prof. Gilligan or Ms. Best by **Friday, February 21**.
- You and your partner will turn in a written report on **Thursday, March 12**.
- You and your partner will give an oral presentation of your research project in the lab on **Monday, March 16**.

Second Half of the Semester

In the second half of the semester, you will analyze data on the economies and energy use of different countries around the world and use these to analyze different policy options for reducing greenhouse gas emissions. The labs will begin with exercises that follow the analyses you will be reading about in the book, *The Climate Fix*, and then you and a partner will conduct a detailed analysis of policy options for a country of your choice to make a transition to a cleaner energy supply.

Policy Analysis for a Country The policy analysis project has the following important dates:

- You and your partner will turn in a written policy analysis report on **Friday, April 17**.
- You and your partner will present the results of your policy analysis in the lab on **Monday, April 20**.

Laboratory Classroom

The laboratory will meet in the Computer Classroom in 120 Wilson Hall. This classroom is equipped with computers that have all the software you need for this class. You are also free to bring your own laptop to the lab. Detailed instructions for installing R, RStudio, git, and (optionally) the LaTeX typesetting system on your computer (for Windows, MacOs, and Linux) are available on the course web site at https://ees3310.jgilligan.org/tools/.

The computer laboratory is accessible using your Vanderbilt ID card 6:00 AM–1:00 AM 7 days a week except when other classes are meeting there. You can check the availability of the computer lab using Vanderbilt's VirtualEMS web app.

Software Tools

We will use four principal software tools for this class. All four are free and available for Windows, MacOS, and Linux. Detailed instructions for downloading and installing them are available on the course web site at https://ees3310.jgilligan.org/tools/:

1. R: statistical analysis software
2. RStudio: a user-friendly interface to R, which makes it much easier to use.

3. Git: a tool for keeping track of revisions in computer code and documents and coordinating working together with other people on a project.

4. LaTeX: This is strictly optional. It is a typesetting package that allows you to produce PDF (acrobat) documents from RStudio. If you choose not to install LaTeX, you can still produce HTML (web) and DOCX (Microsoft Word) documents. The downside is that a full LaTeX distribution can be quite large (several hundred megabytes), so if you are running low on disk space, you might not want to install it.

   LaTeX is installed on the lab computers, so you will always have the option of producing PDF documents there, even if you don't install it on your own computer.

All of this software is installed on the lab computers in Wilson 120, so you do not need to install it on your own computer, but you will need it to do the data analysis and write up your lab reports, so it will probably be convenient for you to install your own copies.